KEES, INC.

400 S. INDUSTRIAL DRIVE – ELKHART LAKE, WISCONSIN 53020 – (920) 876-3391

KITCHEN HOOD BALANCING MANUAL

FORWARD:

A system not properly balanced will seldom be satisfactory and will eventually result in loss of time and future business. A balancing report prepared by the hood sales agency, the installing contractor, or a hired balancing service should be on record.

PROCEDURE: BALANCE EXHAUST AIR FLOW

During this procedure only run the exhaust fan. Do not start the supply fan. Instead, open doors or windows to allow air to enter the kitchen area which balancing the exhaust air flow.

Verify that the hood filters are clean. If there is a fire damper in the exhaust collar, then verify it is open.

Start the exhaust fan. Verify the voltage and the direction of the rotating wheel. Record the revolutions per minute of this wheel using a tachometer. Record the amp draw on the motor as well as the full load amps from the motor nameplate.

Use one of the following three methods to determine the exhaust air flow.

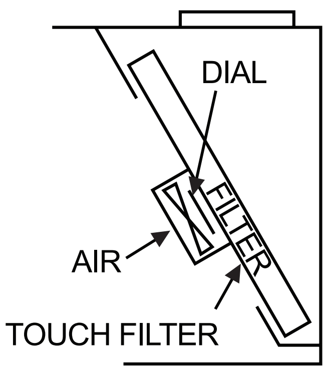
ANEMOMETER (Rotating Vane)

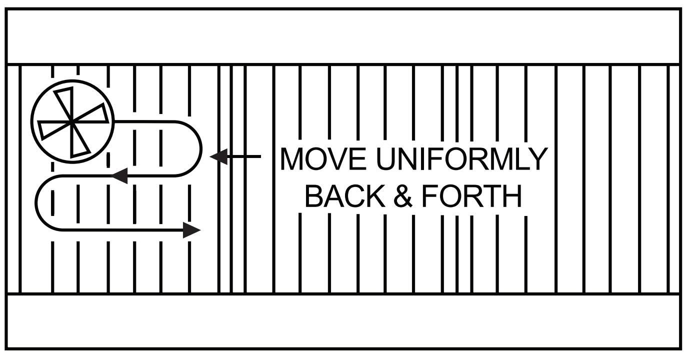
1. Place the dial side of the meter against the filter so the air flows in the correct direction.

2. Verify that the rotating vane is rotating freely and in a clockwise direction.

3. For one minute, uniformly traverse the entire area of each filter; excluding the filter frame. Record these preliminary velocity values. Use the correction table in the anemometer manual to convert these preliminary values into the adjusted average velocity for each filter.

4. Calculate the air flow (CFM) through each filter using the average velocity and the area of the filter. Table 1 gives the effective area for the baffle filters used in KEES hoods. Add these values together to get the total exhaust air flow through the hood.





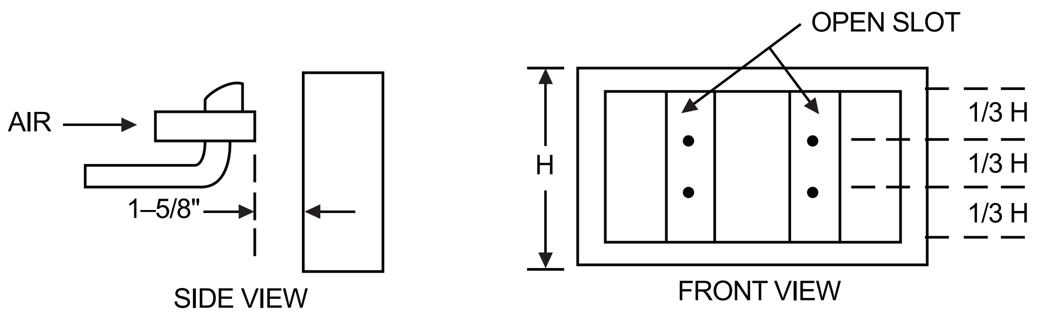
ALNOR VELOMETER

1.Use Jet Nos. 2225, 3930, or exhaust style No. 6070 which is attached to the negative (-) terminal. Set needle at zero using adjustment screw on face of unit.

2. Hold the jet 1-5/8" out from centerline of slotted exhaust opening and take at least two equally spaced readings per slot. Do this for each slot in the filter.

3. Add up all the readings and divide by the number of readings to get the average velocity.

4. Calculate the air flow (CFM) through each filter using the average velocity and the area of the filter. Table 1 gives the effective area for the baffle filters used in KEES hoods. Add these values together to get the total exhaust air flow through the hood.



INCLINED GAUGE

1. Insert a thin tube through a filter slot until the tube end is approximately 6" behind it. Connect the tube to the suction side of a magnehelic gauge, U-tube of water, or an inclined gauge.

2. Record the pressure drop and the size of the filter and repeat for the remaining filters.

3.Use Table 2 to find the air flow through each filter using the filter size and pressure drop values. Add up the air flow (CFM) for each filter to get total exhaust ir flow.

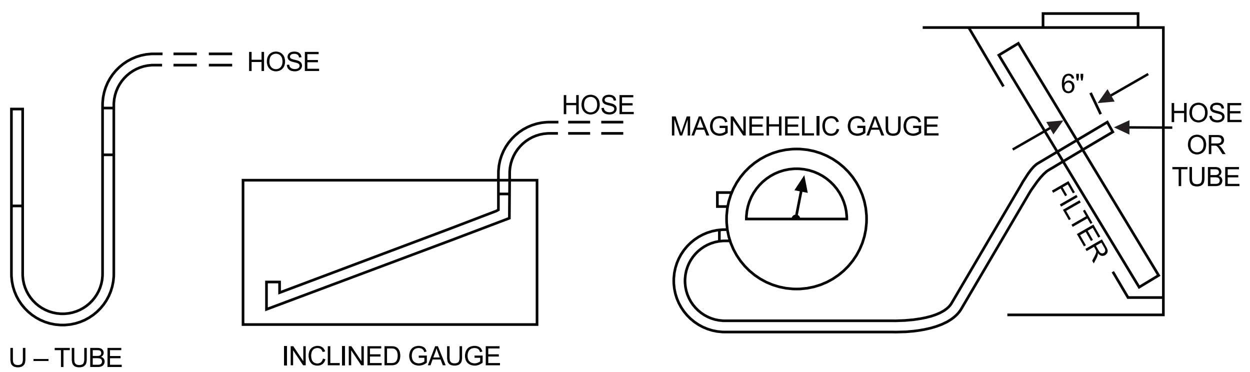


TABLE 1 - EFFECTIVE AREA OF FILTERS

10" x 20" x 2"	1.00 Square Feet
12" x 20" x 2"	1.25 Square Feet
16" x 20" x 2"	1.75 Square Feet
16" x 25" x 2"	2.24 Square Feet
20" x 20" x 2"	2.25 Square Feet
20" x 25" x 2"	2.88 Square Feet
25" x 25" x 2"	3.67 Square Feet

TABLE 2 - FLOW RATE AND PRESSURE DROP

FLOW RATE	FILTER SIZE							
CFM	10 x 20	12 x 16	12 x 20	16 x 16	16 x 20	20 x 20	16 x 25	20 x 25
200	0.13	0.15	0.10	0.07	0.04	0.04	0.04	0.03
250	0.20	0.23	0.16	0.12	0.07	0.06	0.07	0.04
300	0.29	0.33	0.23	0.17	0.09	0.08	0.09	0.06
400	0.52	0.59	0.40	0.30	0.17	0.15	0.17	0.11
450	0.66	0.75	0.51	0.38	0.21	0.19	0.21	0.14
500	0.81	0.93	0.63	0.46	0.26	0.23	0.26	0.18
550	0.98	1.12	0.76	0.56	0.32	0.28	0.32	0.21
600	1.17		0.90	0.67	0.38	0.33	0.38	0.25
650			1.06	0.79	0.45	0.39	0.44	0.30
700				0.91	0.52	0.45	0.51	0.35
750				1.05	0.59	0.52	0.59	0.40
800					0.68	0.59	0.67	0.45
850					0.76	0.67	0.75	0.51
900					0.85	0.75	0.85	0.57
950					0.95	0.83	0.94	0.64
1000					1.05	0.92	1.04	0.71

NOTE:
1. Recommended face velocity is 200 to 400 F.P.M.
2. The first number of size indicates vertical height, the second number represents horizontal width; both are nominal dimensions. Actual dimensions of filters are 7/16" less than nominal. Actual thickness is 1-3/4".

ADJUST EXHAUST AIR FLOW :

If the total air quantity measured is within plus (+) or minus (-) 5% of the design quantity, then the exhaust system is balanced and no adjustment is necessary.

If the air flow needs adjustment then use the fan laws (see equations below) to determine what action to take. Increasing the RPM of the fan will increase the air flow. Decreasing it will decrease the air flow.

If the air flow needs to be increased then calculate the Amps Required to make sure the adjustment does not overload the motor (FLA on motor nameplate).

1. CFM varies directly with RPM.

$$\frac{\text{CFM Required}}{\text{CFM Measured}} = \frac{\text{RPM Required}}{\text{RPM Measured}}$$

2. Static pressure varies as the square of RPM.

$$\frac{\text{Ps Required}}{\text{Ps Measured}} = \left(\frac{\text{RPM Required}}{\text{RPM Measured}}\right)^2$$

3. Amps (HP) varies as the cube of RPM.

$$\frac{\text{AMPs Required}}{\text{AMPs Measured}} = \left(\frac{\text{RPM Required}}{\text{RPM Measured}}\right)^3$$

EXAMPLE:

- Air flow measured is 2000 CFM, but 2200 CFM is required.
- Amps measured is 2.7 A against a motor nameplate reading of 3.6 FLA.
- Fan speed is 640 RPM.

Find the RPM Required and determine if existing motor is large enough.

$$\text{RPM Required} = \text{RPM Measured} \times \frac{\text{CFM Required}}{\text{CFM Measured}} = 640 \times \frac{2200}{2000} = 704 \text{ RPM}$$

$$\text{Amps Required} = \text{Amps Measured}\left(\frac{\text{RPM Required}}{\text{RPM Measured}}\right)^3$$

$$= (2.7)\left(\frac{704}{640}\right)\left(\frac{704}{640}\right)\left(\frac{704}{640}\right) = 2.7 \times 1.1 \times 1.1 \times 1.1$$

= 3.59 —> This is less than the FLA so the motor size is OK.

EXHAUST DUCT DESIGN SUGGESTIONS:

Locate the duct collar as close to the center of hood as possible. Size it for a velocity of 1500 FPM or slightly higher. Do not recommend using the maximum allowed as the smaller duct will increase the pressure drop.

Avoid 90 degree turns in the ductwork. Use long sweep elbows if possible.

Do not stub one duct into another at a right angle. Instead, use a “pair of pants” with sweeping turns when two ducts from a long hood join a vertical riser.

Pitch ductwork back toward the hood to prevent grease from collecting in the ductwork. On long horizontal duct runs utilize in-line centrifugal fans for their ability to handle high pressure drops. Provide access doors for cleaning in the fan housing and the ductwork.